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(56) Documents cited
GB 2238283 A GB 2222667 A GB 2041178 A
GB 1308348 A GB 601957 EP 0299902 A
EP 0250972 A US 4432285 A

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INT CL[5] B64D, F41H, F42D
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(54) An aircraft cargo container

(57) An aircraft cargo container (10) is provided with one or more expandable regions (28) Fig 2 for expansion under blast loading thereby to absorb a portion of the blast energy from a blast within the container (10). The absorbing means may comprise corrugated or concertina shaped sheets (20, 22, 34) which expand under blast loading and together with a blast absorbing material (24). The sheets (20, 22, 34) and material (24) may be provided in one or more panels (12, 14) and/or at one or more edges if required.

Fig. 2.

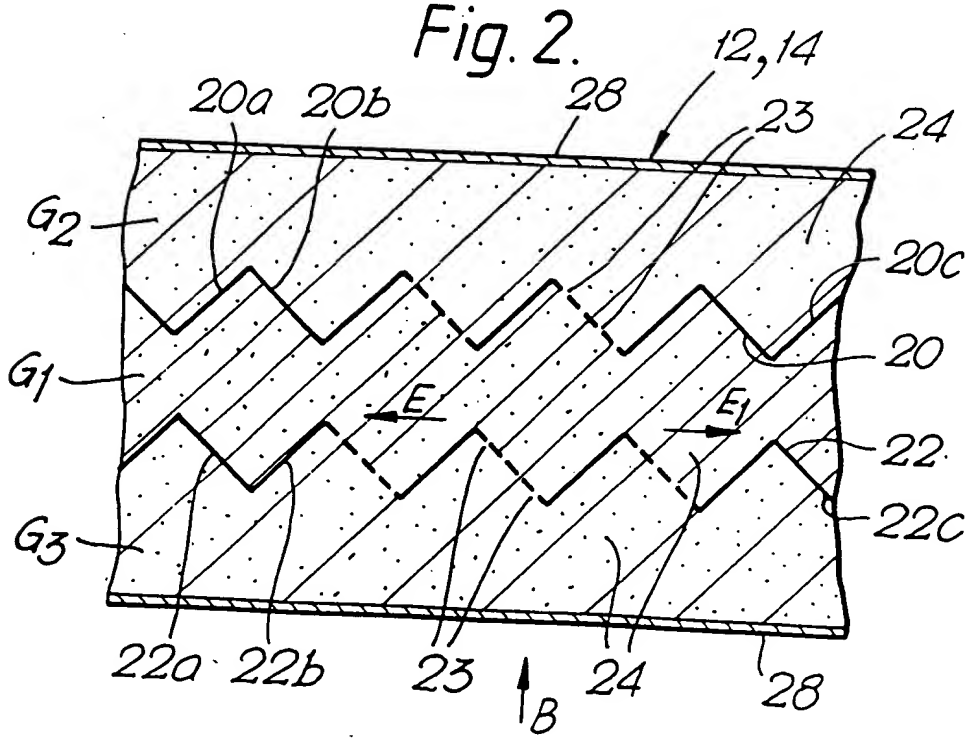

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Fig. 1.

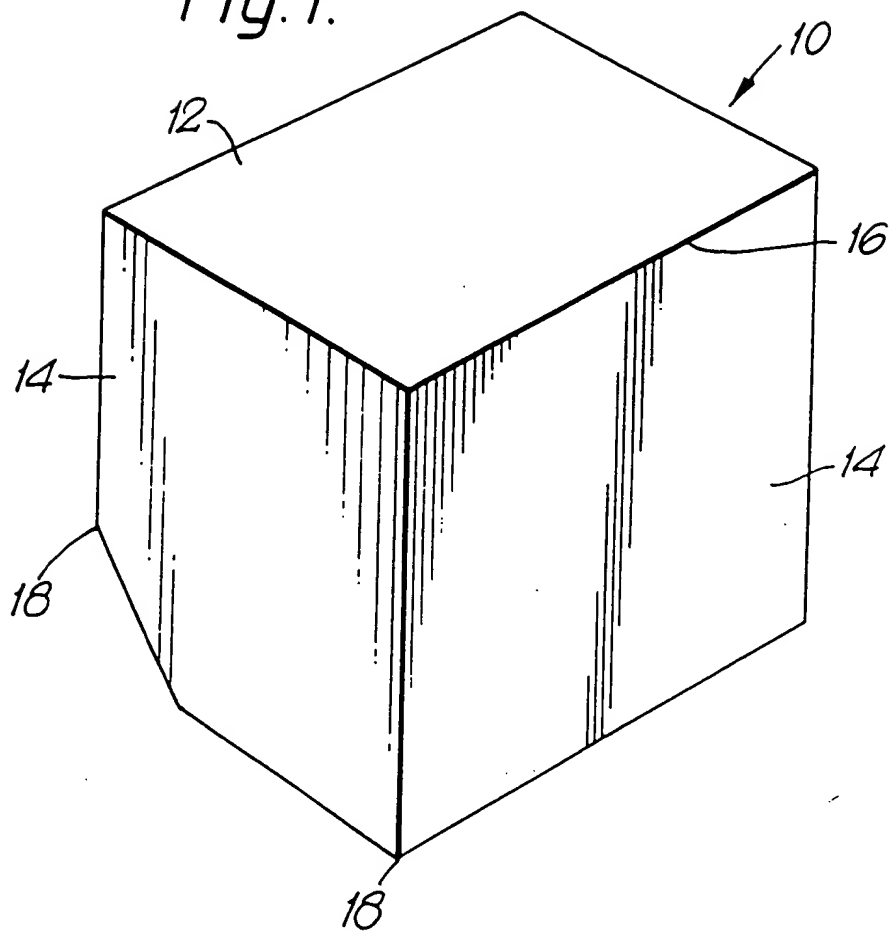

10
12
16
14
14
18
18

Fig. 2.

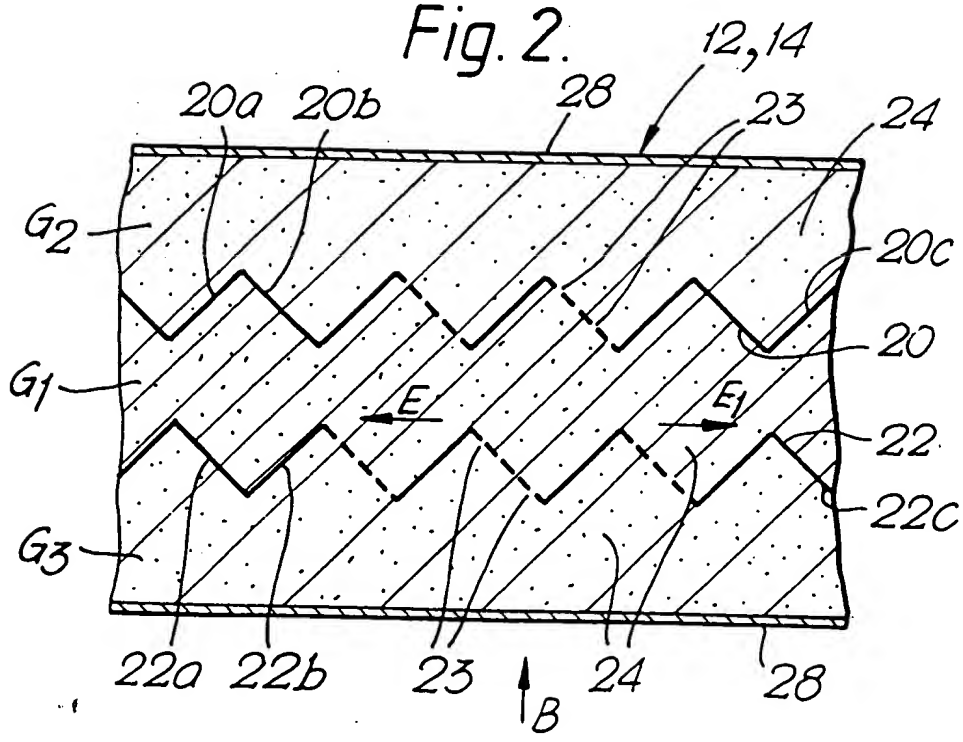

12,14
20a
20b
28
23
24
G2
20c
20
G1
E
E1
22
22c
G3
22a
22b
23
24
28
B

Fig. 3.

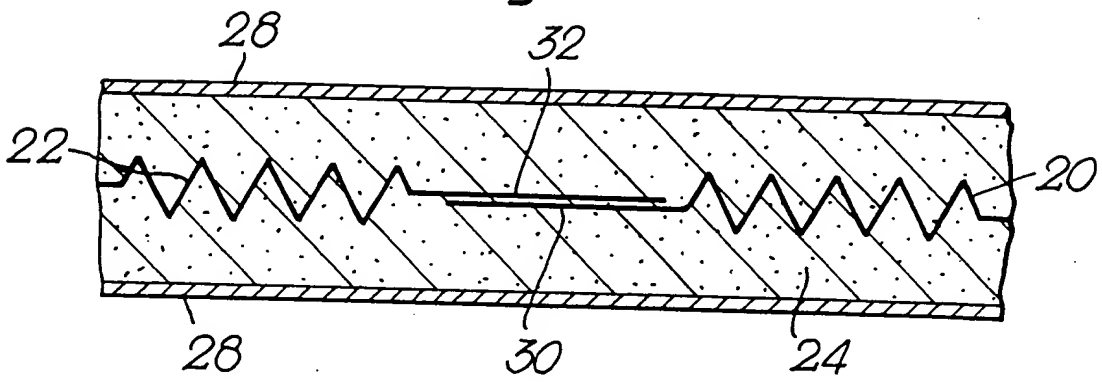


Fig. 4.

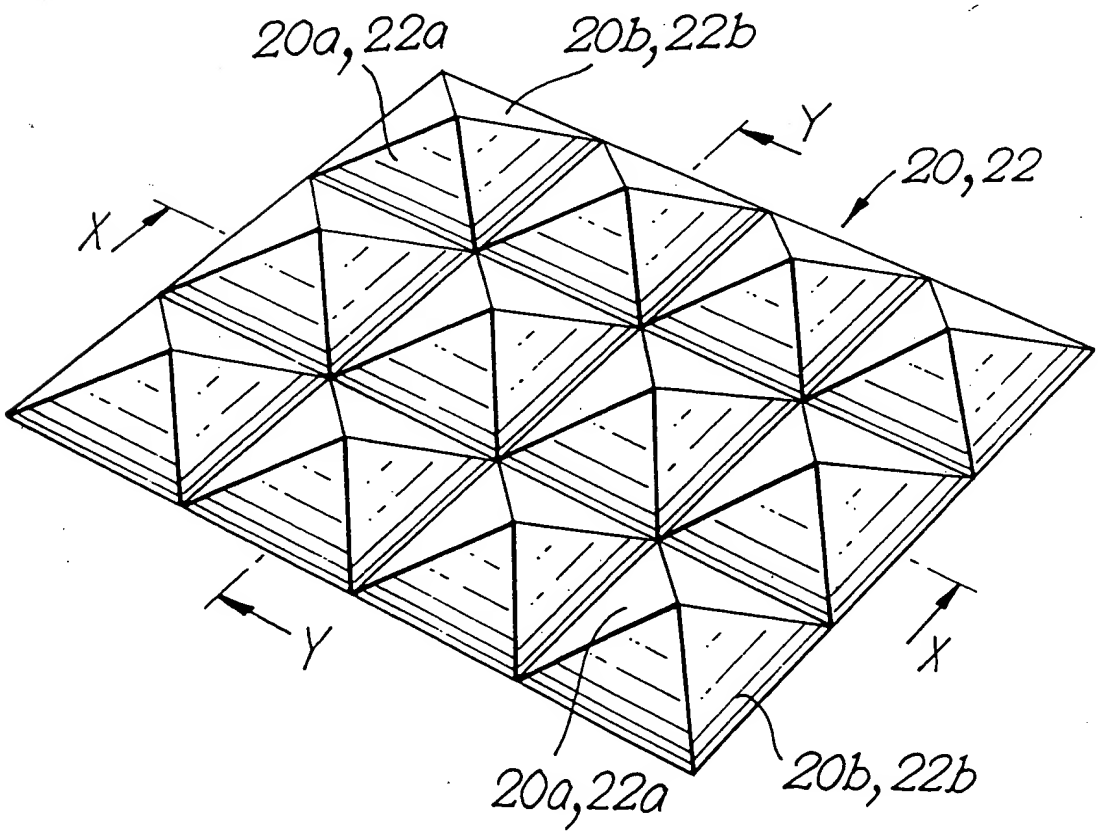


Fig.5.

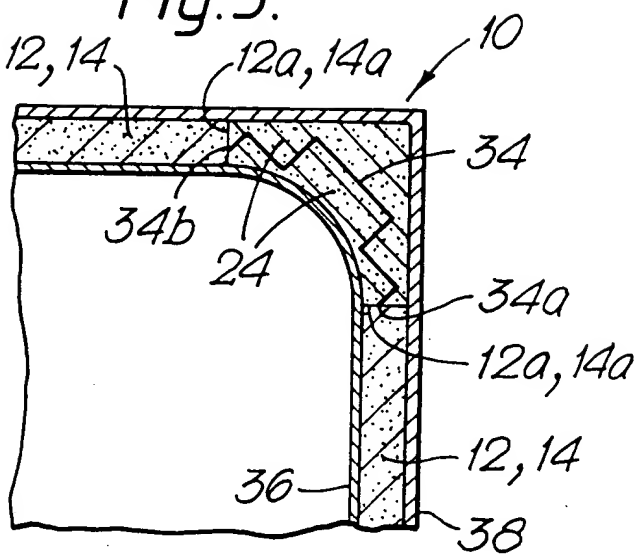
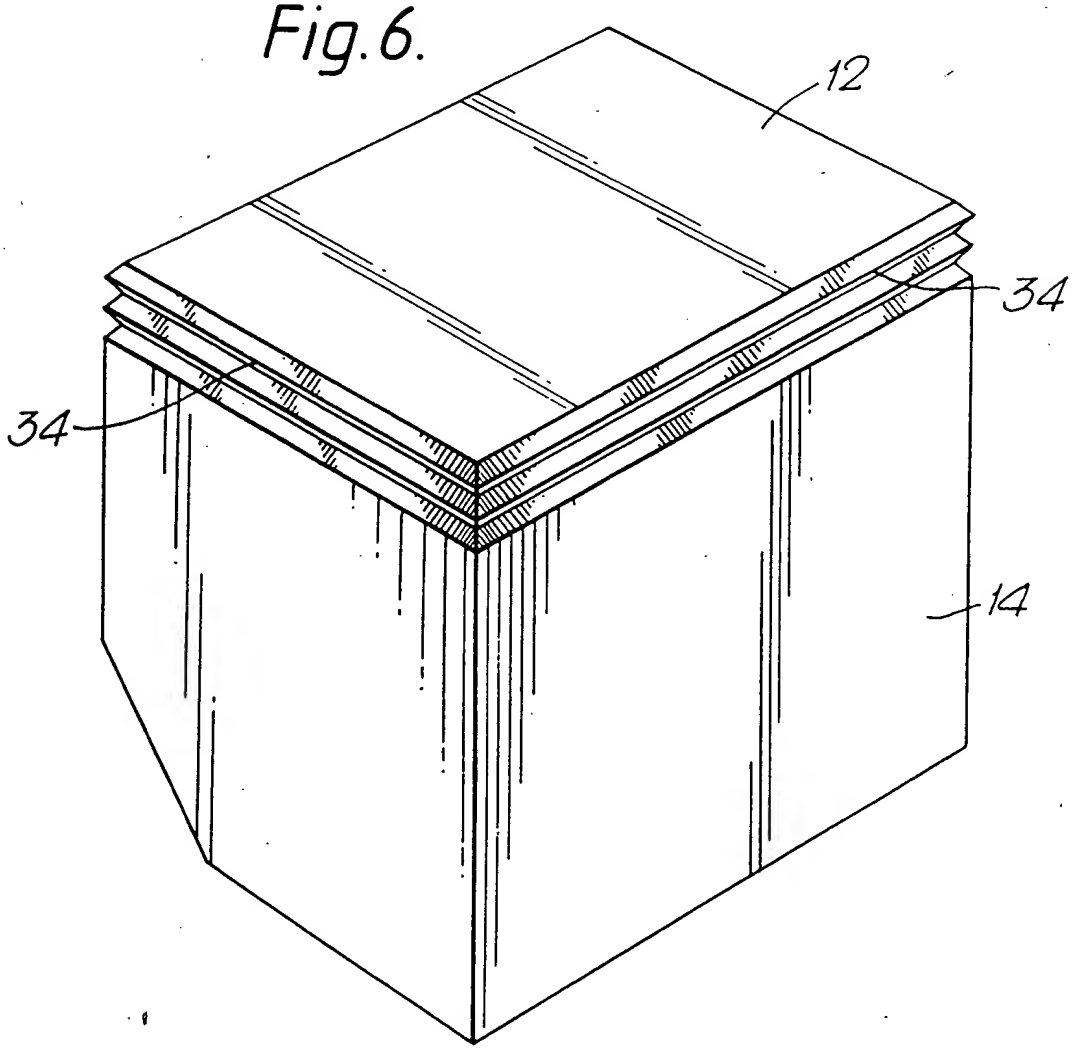


Fig.6.



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AN AIRCRAFT CARGO CONTAINER

The present invention relates to a container and relates particularly, but not exclusively, to a cargo container for use on aircraft which is capable of expanding thereby to facilitate containment of an explosive blast therein.

Experiments on blast mitigating panels for cargo containers show that they have a tendency to 'bow' outwards when an explosive charge is detonated inside the container. The experiments have also indicated that the panels often fail at their edges and corners where they are attached to each other to a frame, before the material of the panel fails.

The longer a blast can be contained, and the more expandable the container, the greater the energy the blast wave has to expend in disrupting the cargo container. The consequence of a longer containment time is expected to be a reduction in impulse loading as a less energetic wave emerges to interact with the structure of the aircraft.

There therefore exists a requirement for a cargo container capable of absorbing a significant proportion of the explosive blast energy from an explosion thereby to reduce impulsive loading on an aircraft structure.

Accordingly, the present invention provides a container formed from a plurality of panels and having a blast attenuation means, said attenuation means comprising one or more expandable regions for expansion under blast loading thereby to absorb a portion of the blast energy contained in the blast.

Preferably, the one or more expandable regions comprises a corrugated or concertina shaped sheet having laterally expanding portions which in operation expand to allow the container to expand before structural failure occurs.

In a particularly advantageous arrangement, each expandable region comprises two corrugated or concertina shaped sheets arranged the one on the other in substantially parallel relationship and defining a gap therebetween.

For a better blast mitigation, the sheets are arranged the one on the other in out of phase relationship.

In one arrangement, each expandable region comprises two corrugated or concertina shaped sheets each having a substantially flat end portion arranged to overlap the substantially flat end portion of the other in a manner which allows sliding of one sheet over the other.

The sheets may be perforated in order to allow a portion of the blast energy to pass therethrough.

In a particularly advantageous arrangement, the container includes a blast absorbing deformable or crushable material on a surface of the sheet for absorbing a portion of the blast energy.

In an alternative arrangement, the blast absorbing deformable or crushable material may be provided between the sheets and/or on a surface of one or both of said sheets.

In a particularly convenient arrangement, the container includes first and second backing sheets between which more expandable regions are contained.

The first and second backing sheets could form the inner and outer surfaces of the container.

The blast attenuation means could form part of or all of one or more of said panels. Alternatively, the blast attenuation means could form one or more jointing portions between one or more of said panels.

In a particularly advantageous arrangement, the blast attenuation means forms a jointing portion along the entire length of each edge of a panel so as to form a container having a bellows like structure.

The sheet or sheets can be connected at one or more ends to one or other of said panels.

The present invention will now be more particularly described by way of example only with reference to the accompanying drawings in which:

Figure 1, is a pictorial representation of an aircraft cargo container according to one aspect of the present invention,

Figure 2, is a cross sectional view of one of the panels shown in Figure 1,

Figure 3 is a cross-sectional view of an alternative form of one of the panels shown in Figure 1,

Figure 4 is an isometric projection of a polymeristic form of sheet material suitable for use in the present invention.

Figure 5 is a cross-sectional view of a corner portion shown in Figure 1 and

Figure 6 is a pictorial representation of an aircraft cargo container according to another aspect of the present invention.

Referring to Figure 1, a conventional aircraft cargo container 10 comprises a top panel 12, four side panels 14 and a base (not shown), joined to each other at edges and corners 16, 18 respectively.

Figure 2 illustrates in cross-sectional form the internal construction of one of the panels 12, 14, shown in Figure 1. The panel 12, 14 comprises one or more corrugated or concertina shaped sheets 20, 22 having laterally expanding portions 20a, 20b and 22a and 22b respectively. When a plurality of sheets are provided they are preferably arranged substantially parallel to each other so as to define a gap G therebetween. The sheets may be arranged in phase or out of phase with each other in order to optimise the blast absorbing properties thereof. An out of phase relationship is shown in Figure 2. One or other, or both, sheets may be perforated by holes 23 in order to allow a portion of the blast energy to pass therethrough for reasons which will be explained later. The gap G between the sheets 20, 22 preferably provided with a packing of blast absorbing deformable or crushable material 24 which may also be provided on outer surfaces of the sheets as well if required. Whenever the blast absorbing material 24 is provided on the outer surfaces a protective backing sheet of metal 28 may be provided thereover in order to protect the material 24 from unnecessary damage during handling and further enhance the blast absorbing properties of the panel 12, 14. The ends 20c, 22c may be anchored to another member (not shown) if desired.

Referring now to figure 3, in which an alternative form of panel is shown, the sheets 20, 22 may be provided with an extended end portion 30, 32 arranged to overlap each other as shown. Such an arrangement has the advantage of enhancing the blast absorbing capabilities of the panel as will be described later and helps reduce the width of the panel itself. Blast absorbing material 24 is placed between the sheets 20, 22 and protective outer surfaces 28.

Figure 4 illustrates an alternative form of sheet material 20, 22 in which the corrugations or concertina arrangements are provided bi-directionally in order to form a polymeristic or similar structure as shown. This type of arrangement has the advantage of being much stronger than a uni-directionally corrugated or concertina shaped sheet and provides an improved blast absorbing capability. It will be appreciated that such a sheet is corrugated or concertina shaped when viewed in cross-section in the directions of arrows XX or YY and hence any reference to corrugated or concertina shaped structures herein is considered to cover polymeristic or such similar structural arrangements as well. Any one or more of the sheets, 20, 22 or the expandable element 34 may take the form of a polymeristic or similar shaped structure if desired. Indeed the arrangement illustrated in Figure 2 when incorporating one uni-directionally corrugated or concertina shaped sheet and one bi-directionally corrugated or concertina shaped sheet will provide the panel of high blast absorbing capability.

Figure 5 illustrates an edge or corner arrangement of the present invention. The panels 12, 14, which may each be provided with a blast absorbing structure as described above, are linked to an adjacent panel by a corrugated or concertina shaped expanding element 34. The element 34 is made from sheet material and may be provided with holes (not shown) therein for the purpose described above. The edges 34a, 34b of the element are connected to the edges 12a, 14a of the adjacent panel so as to anchor the panels together. Blast absorbing material 24 may be provided in the space between the element and protective inner and outer skins 36, 38 respectively. Element 34 may take the form of the sheet shown in Figure 4 if desirable.

The edge or corner arrangement may be provided on all four edges of one or more panels as shown in Figure 6. Such an arrangement gives the container 10 a bellows like structure the operation of which will be described below.

In operation, each of the above mentioned arrangements absorbs blast energy by causing the blast wave to do essentially expansive and compressive work thereby reducing the amount of blast energy which emerges from the container to interact with the structure of the aircraft.

The arrangement shown in Figure 2 operates by a combination of expansion of the sheets 20, 22 and compression of the blast absorbing material 26. A blast wave hitting the panel in the direction of arrow B acts to compress the blast absorbing material 24 and expand the corrugated or concertina shaped

sheets 20, 22 in the direction of arrows E E. Lateral expansion of the sheets acts to further compress the blast absorbing material 24 thereby further enhancing the overall blast absorbing capabilities of the overall structure. Holes 23, if provided, act to allow a portion of the blast energy to pass directly through the sheets and impinge directly on the blast absorbing material therebehind. The holes also help reduce the possibility of the sheets suffering structural failure if they experience excessive blast energy levels as the extra blast energy passes through the holes rather than damage the sheets themselves. An out of phase sheet arrangement helps increase sheet to blast absorbing material interaction. However, it will be appreciated that other phase relationships could be used without altering significantly the blast absorbing capabilities.

The Figure 3 embodiment operates in substantially the same manner as that described above, with the exception of the extended end portions 30, 32. These portions, which are arranged to overlap one another, slide over each other when they experience an explosive blast wave thereby allowing frictional contact to be employed in blast mitigation. An adhesive layer, or another high friction material, may be placed between the sheets to increase the friction therebetween. Lateral movement of the corrugated or concertina shaped portions will also take place as described above.

The operation of the edge/corner arrangement of Figure 5, is also substantially the same as that described for the Figure 2 embodiment. However, because the edges 34a, 34b of the

element 34 are anchored to the adjacent panels 12, 14 they act to maintain the mechanical joint between the panels until the element itself bursts or ruptures due to the impact of the explosive blast energy.

If an edge/corner arrangement is employed along the entire length of each edge of one or more panels 12, 14, the container will take the form of a bellow, as shown in Figure 6. In operation, this arrangement allows the entire panel 12, 14 to move whilst the blast wave expands the corrugated or concertina shaped elements 34 and crushes the shock absorbing material 24.

CLAIMS

1. A container formed from a plurality of panels and having a blast attenuation means, said attenuation means comprising one or more expandable regions for expansion under blast loading thereby to absorb a portion of the blast energy contained in the blast.

2. A container as claimed in claim 1 in which the one or more expandable regions comprises a corrugated or concertina shaped sheet having laterally expanding portions which in operation expand to allow the container to expand before structural failure occurs.

3. A container as claimed in claim 2 in which each expandable region comprises two corrugated or concertina shaped sheets arranged the one on the other in substantially parallel relationship and defining a gap therebetween.

4. A container as claimed in claim 3 in which the sheets are arranged the one on the other in out of phase relationship.

5. A container as claimed in claim 2 in which each expandable region comprises two corrugated or concertina shaped sheets each having a substantially flat end portion arranged to overlap the substantially flat end portion of the other in a manner which allows sliding of one sheet over the other.

6. A container as claimed in any one of claims 2 to 6 in which said one or more sheets are perforated.

7. A container as claimed in claim 2 including a blast absorbing deformable or crushable material on a surface of said sheet.

8. A container as claimed in any one of claims 3 to 7 including a blast absorbing deformable or crushable material between the sheets and/or on a surface of one or both of said sheets.

9. A container as claimed in any one of claims 1 to 8 including first and second backing sheets between which one or more expandable regions is/are contained.

10. A container as claimed in claim 9 in which said first and second backing sheets form inner and outer surfaces of the container.

11. A container as claimed in any one of the preceding claims in which the blast attenuation means forms part of or all of one or more of said panels.

12. A container as claimed in any one of claims 1 to 11 in which the blast attenuation means forms one or more jointing portions between one or more of said panels.

13. A container as claimed in claim 12 in which the blast attenuation means forms a jointing portion along the entire length of each edge of a panel so as to form a container having a bellows like structure.

14. A container as claimed in any one of claims 2 to 13 in which the corrugated or concertina shaped sheet or sheets are corrected at one or more ends to one or other of said panels.

15. A container substantially as described herein with reference to and as illustrated in figures 1 to 6 of the accompanying drawings.

Examiner's report to the Comptroller under Section 17 (The Search report)	GB 9127408.4
Relevant Technical Fields (i) UK Cl (Ed.) F3C (CP2) (CPK) (CAJ) E1D (DF115) B7W WFH (ii) Int Cl (Ed.5) F41H, F42D, B64D.	Search Examiner PAUL GAVIN Date of completion of Search 31 MARCH 1992
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) ONLINE DATABASE: WPI	Documents considered relevant following a search in respect of Claims :- ALL

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Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 2238283 A	(ROYAL ORDANCE) whole document	1 at least
X	GB 2222667 A	(THE POST OFFICE) whole document	1 at least
X	GB 2041178 A	(SACKS) whole document	1 at least
X	GB 1308348	(HOESCH) whole document	1 at least
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